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(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
 28.01.1998 Bulletin 1998/05

(51) Int. Cl.⁶: **C30B 25/14**, **C30B 31/16**,
C23C 16/44

(21) Application number: 97305255.8

(22) Date of filing: 15.07.1997

(84) Designated Contracting States:
AT BE CH DE DK ES FI FR GB GR IE IT LI LU MC
NL PT SE

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(30) Priority: 24.07.1996 US 690265

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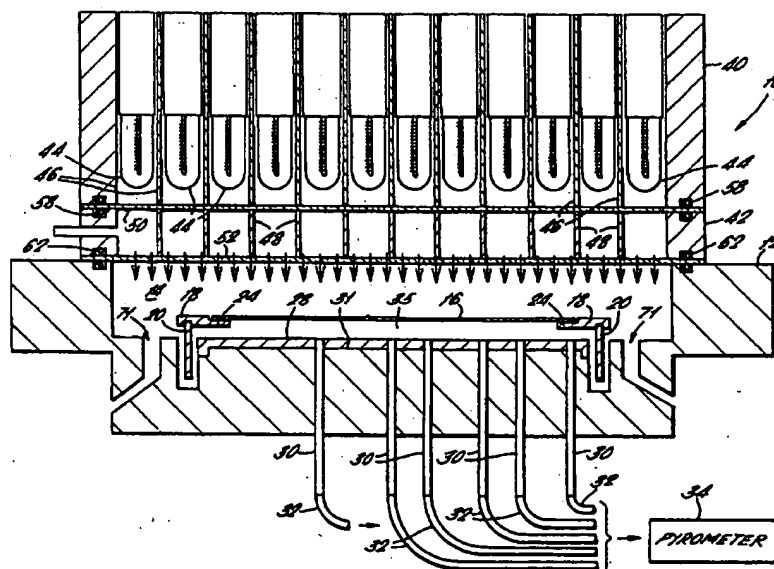
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(54) **Multi-zone gas flow control in a process chamber**

(57) A showerhead for introducing gas from one or more external supplies into a substrate processing chamber, the showerhead including a faceplate including a plurality of gas injection ports through which gas is injected into the chamber, wherein the plurality of gas injection ports includes a first subset of gas injection ports and a second subset of gas injection ports; a first

gas distribution system which during use delivers a first gas to the first subset of injection ports for injection into the chamber; and a second gas distribution system which during use delivers a second gas to the second subset of injection ports for injection into the chamber.

FIG. 1



Description

Background of the Invention

The invention relates generally to gas distribution in processing chambers, such as RTP chambers.

Typically, rapid thermal processing systems utilize a high intensity light source to rapidly heat a substrate that is held within a processing chamber, sometimes under vacuum conditions. The light source, which may consist of an array of high intensity lamps, is located outside of the chamber and adjacent to a window through which the light passes into the chamber. Inside of the chamber and on the other side of the window, the substrate is supported in such a manner that it can be heated by the incoming light. In some systems, the substrate is supported on a susceptor and it is the susceptor that is directly heated by the light. In other systems, the substrate is supported by a support ring which leaves both the front and back of the wafer substantially exposed to the atmosphere in the chamber and it is the frontside of the substrate which is directly heated by the light. The wavelength of the light is selected so that it is substantially absorbed by the substrate or the system component that is being heated and the material of which the window is made is selected so that it is substantially transparent to the light. Often, quartz is used for the window.

Two systems which utilize support rings are described in greater detail in U.S. Patent 5,155,336 and in U.S. Patent Application Serial No. 08/359,302, filed 12/19/94, both of which are incorporated herein by reference.

For many processes that are performed within the chamber (e.g. deposition, etch, epitaxial processes, doping, growing oxides, nitridation, etc.), it is necessary to deliver a process gas into the chamber. Moreover, the process gas must be delivered so as to produce substantially uniform results over the surface of the wafer. One approach that has been used is to inject the gas to the side of the substrate and let it flow over the surface of the substrate (see U.S. 5,155,336 referenced above). Another approach has been to use a showerhead that is positioned adjacent to the substrate and on the side of the substrate that is opposite the side that is being heated by the high intensity light (see U.S.S.N. 08/359,302 also referenced above). Though these and other various approaches to gas injection do exist, there is always a need to improve upon them.

Summary of the Invention

In general, in one aspect, the invention is a showerhead for introducing gas from one or more external supplies into a substrate processing chamber. The showerhead includes a faceplate including a plurality of gas injection ports through which gas is injected into the chamber, wherein the plurality of gas injection ports

includes a first subset of gas injection ports and a second subset of gas injection ports. The invention also includes a first gas distribution system which during use delivers a first gas to the first subset of injection ports for injection into the chamber; and a second gas distribution system which during use delivers a second gas to the second subset of injection ports for injection into the chamber.

Preferred embodiments include the following features. The showerhead also includes a plenum chamber formed behind the faceplate and which receives gas from the one or more external supplies. The plenum chamber is divided into a plurality of internal chambers isolated from each other and including a first internal chamber and a second internal chamber; and a first and a second gas inlet. The first inlet is coupled to the first chamber and the second inlet is coupled to the second chamber. The showerhead, which is used with a lamp head to heat the substrate to a process temperature, also includes a top window on a side of the showerhead that is adjacent to the lamp head; and a bottom window on a side of the showerhead that is adjacent to the substrate during processing. The top and bottom windows define a cavity therebetween and are transparent to the radiation from the source in the lamp head and the bottom window functions as the faceplate.

Also in preferred embodiments, the plurality of injection ports are a plurality of holes through the bottom window. In addition, the showerhead further includes a top plate with a plurality of holes; a bottom plate with a plurality of holes equal in number to the plurality of holes in the top plate; and a plurality of tubes equal in number to the plurality of holes in the top plate. Each of the plurality of tubes connects a different one of the holes in the top plate to a corresponding one of the holes in the bottom plate; and the top window is adjacent to the top plate and the bottom window is adjacent to the bottom plate. At least one of the top and bottom plates has a first array of channels formed therein for distributing gas to the first subset of injection ports, and at least one of the top and bottom plates has a second array of channels formed therein for distributing gas to the second set of injection ports.

In general, in another aspect, the invention is a thermal processing system including a chamber defining a processing cavity; a lamp head; a showerhead positioned between the lamp head and the processing cavity in the chamber; and a substrate support mechanism within the chamber and spaced apart from the adapter plate. The showerhead is constructed as described above.

In general, in yet another aspect, the invention is a showerhead for introducing gas from one or more external supplies into a substrate processing chamber. The showerhead includes a faceplate including a plurality of gas injection ports through which gas is injected into the chamber, wherein the plurality of gas injection ports includes a plurality of subsets of gas injection ports; and

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